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Chiborg: a Bayesian jackknife framework for testing consistency of multiple measurements

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Internal consistency is crucial when combining data to form a precision measurement. If we can identify subsets of the data that lack consistency with others, we can improve the quality of the measurement by excluding that data or reanalysing it to remove the source of the inconsistency. In this talk, we present a Bayesian formulation for testing internal consistency that evaluates how likely each subset of the data is to be systematically biased relative to some null hypothesis. This formulation is advantageous to other consistency checks in that it points directly to the data that are most likely to be contentious and ranks various alternative scenarios in an easily interpreted way. We also incorporate a decision theoretic framework that allows the analyst to tune the results to a particular objective. These qualities make it an effective tool in a blind analysis pipeline, where direct examination of the data to answer the same question may spoil the blinding procedure.

We implement this in an open-source python package called Chiborg, which is available on GitHub with example Jupyter notebooks that serve as user tutorials. In this talk, we demonstrate its behaviour on a simulated example, and use it to statistically justify combining several subsets of data into a leading upper limit on the 21-cm power spectrum placed by HERA using its first observing season. Given the versatility and success of Chiborg, we suggest different ways it can be used in other radio experiments, as well as in reconciling tensions in measurements of cosmological quantities such as the Hubble parameter.